Dkt. 00250

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: CHUAN-BAO WANG et al	Group Art Unit: 1743 Examiner: B. Sines
Serial No.: 09/771,882	
Filed: January 30, 2001	

For: POISON RESISTANT COMBUSTIBLE GAS SENSORS AND METHOD FOR WARNING OF POISONING

DECLARATION UNDER 37 CFR 1.132

Honorable Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

I, Chuan-Bao Wang do hereby declare as follows:

I am a named inventor of the above-identified patent application.

I am familiar with the prior art cited by the Examiner in the Final Office Action mailed January 11, 2005.

The Final Office Action alleges that one of ordinary skill in the art "would have had a reasonable expectation of success of incorporating the coating layer system of Friese et al., with the gas sensor of Jones et al., in order to provide a gas sensor with improved performance characteristics when exposed to contaminants from exhaust gases."

In order to test this allegation, I performed a comparative test of a gas sensor according to the invention and two gas sensor utilizing coating layer systems disclosed by Friese et al.

A gas-sensing element according to this invention (Similar

to EXAMPLE 1 of the application) was fabricated by preparing a slurry "A" by adding 0.2 g $PdCl_2$ and 2.0 g porous alumina into 25.0 ml de-ionized water. The slurry "A" is then applied to a coil, followed by passing a current through the coil to heat it up to 500-700°C to drive off the water from the slurry, consolidate the alumina deposit and decompose palladium chloride to palladium oxide and metal form. Multiple coats and heating were applied until a desired size was obtained. The resulting pellet "P" with only an inner layer was used for further forming Sensor 1 (according to the invention) and Sensor 2 (comparative).

A porous alumina-supported lithium oxide (Li_2O/Al_2O_3) was prepared by incipient impregnation of 1.0 g porous alumina with 3.0 ml of 1 M aqueous solution containing lithium nitrate ($LiNO_3$). The resulting paste was subsequently heated in an oven at 60°C for 1.5 hrs, 120°C for 1 hr and 650°C for 2 hrs to completely decompose lithium nitrate to lithium oxide supported on the surface of alumina. Then, a slurry "B" was prepared by adding 0.3 g the above alumina-supported lithium oxide (Li_2O/Al_2O_3) into 3.0 ml de-ionized water. The slurry "B" was applied onto the one pellet "P", and heating was subsequently applied to form the outer layer. More than one coat was be applied to obtain a desired thickness of the outer layer and form Sensor 1 according to the invention.

A comparative gas-sensing element (Sensor 2) was prepared according to the teachings of Friese et al, by the method described at column 3, lines 21-31. According to this method, a further pellet "P" described above was immersed for 3 minutes in a solution "C" of $LiNO_3$ (1 M) and $Al(NO_3)_3$ (1 M) at room temperature. The solution was allowed to drip off for ~10 minutes., and the pellet "P" was then heated to 1000°C in air for 2 hours to decompose $LiNO_3$ and $Al(NO_3)_3$ to oxides.

Given the initial layer of alumina with platinum catalyst,

Sensor 2 corresponds to the suggestion alleged in the Final Office Action of the Jones et al sensor, modified by depositing a layer for removing contaminants, according to Friese et al.

A further comparative gas-sensing element (Sensor 3) was fabricated according to Friese et al invention, by the method described at column 2, lines 16-22, in which a mixture of catalyst and contaminant-removing compound are introduced directly into a porous covering layer. According to this method, a slurry "D" was prepared by adding 2.0 g porous alumina into 25.0 ml de-ionized water. The slurry "D" was then applied to a coil, followed by passing a current through the coil to heat it up to 500-700°C to drive off the water from the slurry and consolidate the alumina deposit. Multiple coats and heating were applied until a desired size was obtained. The resulting pellet "Q" with the inner layer containing alumina without catalyst was then immersed for 3 minutes in a solution "E" containing $LiNO_3$ (1 M), $Al(NO_3)_3$ (1 M), and $PdCl_2$ (1 M) at room temperature in order to simultaneously introduce the mixed metal oxides and the catalyst. Then the solution was allowed to drip off for ~10 minutes, and the pellet "Q" was heated to 1000°C in air for 2 hours to form Sensor 3.

A reference bead was fabricated by applying an aqueous solution containing aluminum nitrate to a coated coil, followed by passing a current through the coil to heat the coil to 500-900°C to decompose aluminum nitrate to alumina. Multiple coats and heat were applied until a desired size was obtained. Then, an aqueous potassium hydroxide solution was applied so that the catalytic activity of alumina was completely suppressed.

Reference beads prepared in this manner were paired with Sensor 1, Sensor 2, and Sensor 3, as prepared above, for testing. These three sensors were each connected into a Wheatstone bridge circuit (see Fig. 1 of the present application) and tested using 1.0 % methane/air.

Results are set forth in the Table, below:

Sensitivity comparison

Sensor	Sensitivity (mv/%methane)
1	18.2
2	0.05
3	3.6

It was observed that only the sensor fabricated according to the claimed invention (Sensor 1) exhibited high sensitivity to methane (18.2 mV/% methane). The sensor (Sensor 2) fabricated according to the Friese et al method described in column 3, lines 21-31, and corresponding to a combination of Jones et al and Friese et al, exhibited almost zero sensitivity (0.05 mV/% methane); it is believed that this occured because the catalyst was physically covered by lithium and aluminum oxides and poisoned by lithium (a well-known catalyst poison). The sensor (Sensor 3) fabricated according to the Friese et al method described in column 2, lines 16-22 also exhibited low sensitivity (3.6 mV/% methane); it is thought that this occurred because a very small amount of catalyst was still accessible to methane, and the catalyst was partially poisoned.

I further declare that all statements made by me herein are true and all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the application or any patent issued thereon.

3-18-2005
Date

Chuan-Bao Wang